

Design Exception Letters



A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

March 22, 2004

TO: David Allocco, P.E.
Assistant State Engineer
Roadway Engineering Group

THRU: Mary Viparina, P.E. *MV*
Manager
Predesign Section

FROM: Michael R. Chase, P.E.
Project Manager
Stanley Consultants Inc.

RE: Design Exception/Variance Requests on Interstate 17 (MP 214 to 244.5)
TRACS No. 17 MA 215 H5162 01L
I-17 Widening & Table Mesa TI Reconstruction

Dear Mr. Allocco:

The first phases of the subject construction project are listed in ADOT's 2004-2008 and Tentative 2005-2009 Five Year Transportation Facilities Construction Program for Fiscal Years 2008 and 2009.

This project includes widening Interstate 17 to five general use lanes and an HOV lane in each direction from SR 101L to State Route 74/Carefree Highway, four general use lanes and an HOV lane in each direction from Carefree Highway to New River Road, and four general use lanes in each direction from New River Road to Black Canyon City. The study also includes reconstruction of the current interchange at I-17 and Table Mesa Road. Recommendations for modifications and additions to the adjacent frontage road system between Rose Garden Lane and Carefree Highway were also made as part of the study.

Construction is anticipated to occur over several years in up to six different phases, with the first phase adding one general use lane and an HOV lane from SR 101L to Carefree Highway. Until the ultimate widening is completed and new structures over I-17 are constructed to accommodate the ultimate roadway section, design exceptions may be necessary to address interim conditions. These temporary design exceptions, including reduced shoulder widths and deficient vertical clearances, will be requested during final design if necessary.

With respect to the Design Exception and Design Variance Process Guide, this project will "Widen the Existing Roadway." Consequently, design exceptions were evaluated against AASHTO Controlling Design Criteria in the 1990 AASHTO Green Book and design variances were determined using values specified in the ADOT Roadway Design Guidelines. When evaluated using the 2001 AASHTO Green Book values, design exceptions for vertical stopping sight distance would be reduced to only two sag vertical curves on southbound I-17 (MP 239.70 to 239.60 and MP 238.7 to MP 238.6), which are 42 feet and 61 feet less than the recommended 570 feet, respectively.



Design Exceptions for vertical stopping sight distance, maximum grade, bridge structural capacity, and bridge rail structure and geometry are being requested for this project. The existing roadway will be reconstructed south of Carefree Highway (MP 224); therefore, design exceptions will not be required in the southern portion of the study corridor. The table below lists the location for each exception requested.

DESIGN EXCEPTION	LOCATION (Milepost or Structure)	Value	ASSET VALUE	DIFF.
Vertical Stopping Sight Distance	Northbound (NB) 232.00 - 232.20	634'	650'	16'
	NB 232.80 - 233.00	624'	650'	26'
	NB 237.20 - 237.50	593'	650'	57'
	NB 238.20 - 238.30	638'	650'	12'
	NB 240.00 - 240.40	617'	650'	33'
	NB 242.20 - 242.30	631'	650'	19'
	SB 239.70 - 239.60	528'	650'	122'
	SB 238.70 - 238.60	509'	650'	141'
	SB 236.00 - 235.70	616'	650'	34'
	SB 233.70 - 233.50	636'	650'	14'
	SB 232.20 - 232.00	635'	650'	15'
Maximum Grades	NB 237.4 - 238.3	5.00%	4.00%	1.00%
	SB 238.4 - 238.7	5.167%	4.00%	1.167%
Bridge Structural Capacity	New River Br NB (MP 231.40)	HS 16.7	HS 20	3.3
	Little Squaw Creek Br NB (MP 239.20)	HS 19.4	HS 20	0.6
	Rock Springs TI UP NB (MP 242.10)	HS 18.9	HS 20	1.1
	Skunk Creek Br SB (MP 219.11)	HS 15.0	HS 20	5.0
	Deadman Wash Br SB (MP 226.95)	HS 14.4	HS 20	5.6
	New River Br SB (MP 231.40)	HS 14.4	HS 20	5.6
	Moores Gulch Br SB (MP 238.60)	HS 17.2	HS 20	2.8
	Little Squaw Creek Br SB (MP 239.55)	HS 17.2	HS 20	2.8
	Rock Springs TI UP SB (MP 242.25)	HS 18.9	HS 20	1.1
Bridge Rail Geometry	Pioneer TI UP (MP 225.50)	--	--	--
	Mud Springs UP (MP 242.98)	--	--	--
Bridge Rail Structure	Mud Springs UP (MP 242.98)	--	--	--



Evaluation and Justification for Design Exceptions:

Vertical Stopping Sight Distance: This study recommends that the existing profile be matched north of Carefree Highway. Modifying vertical curves to provide longer stopping sight distances would necessitate extensive earthwork and re-grading. Subsequently, drainage structures would need to be replaced to accommodate new grades due to an increase or decrease in cover. Several structures, including the northbound Moore's Gulch bridge at MP 238.20, would need to be replaced to accommodate the new grade. Profile adjustments should be analyzed during final design to improve the vertical stopping sight distances and grades and ultimately reduce the number of design exceptions.

Maximum Grades: As discussed above, the study recommended matching existing grades north of Carefree Highway. Both locations where the maximum grade is exceeded are adjacent to the bridges over Moore's Gulch (NB MP 238.20 and SB MP 238.60). The replacement of these bridges is not included in this study; therefore, profile adjustments should be coordinated with the eventual replacement of these structures.

Bridge Structural Capacities/Bridge Rail Geometry/Bridge Rail Structure: Correcting the existing deficient structural capacities would require the total replacement of or major structural modifications to nine bridges within the study area. It was determined during the study process that only those bridges that were required to be replaced due to widening of mainline I-17 would be included in the project scope. Of the remaining structures within the study area, it was established that structurally deficient or functionally obsolete bridges would be replaced within ADOT's normal bridge replacement program. As stated on the ADOT Bridge Evaluation, all of the listed structures rated below HS-20 are "carrying normal traffic loads without showing any serious structural distress."

Design Variances for minimum loop ramp radius for the SB entrance ramp and NB exit ramp at the I-17/ Deer Valley Road TI are requested for the subject project (see attached exhibit Page 6). The justification for these variances follows:

Southbound Entrance Ramp at Deer Valley TI: The existing southbound entrance loop ramp at Deer Valley Road must be reconstructed to accommodate the widening of I-17. The minimum radius of the existing loop ramp is 154 feet. The proposed loop ramp configuration (minimum radius = 158 feet) is constrained by the existing southbound exit ramp. The existing ramp would need to be shifted outward and approximately 3.4 acres of new right-of-way would need to be acquired to provide a larger-radius design (ADOT Roadway Design Guidelines allow a minimum radius of 250'). Since there is extensive development around the interchange, the right-of-way costs would be high and several business and residential relocations would be necessary.

Northbound Exit Ramp at Deer Valley TI: A northbound exit loop ramp is recommended in the northeast quadrant of the interchange, replacing the existing standard northbound exit ramp. The northbound loop ramp is recommended to maximize the weaving distance between the SR 101L system interchange and the Deer Valley exit. The proposed loop ramp configuration (minimum



radius = 150 feet) is constrained by the existing northbound entrance ramp. The existing ramp would need to be shifted outward and approximately 1.5 acres of new right-of-way would need to be acquired to provide a larger-radius design (ADOT Roadway Design Guidelines allow a minimum radius of 250 feet). Since there is extensive development around the interchange, the right-of-way costs would be high and several business relocations would be necessary.

As part of the I-17 widening study, traffic and weaving operations were analyzed at the northbound exit ramp at the Deer Valley Road TI. The existing geometrics for northbound I-17 provide two through lanes and an auxiliary lane between the northbound SR 101L on ramp and the northbound Deer Valley Road off ramp. This configuration provides acceptable level of service (LOS D) during current PM and off-peak hour traffic periods, but breaks down (LOS E) during the current AM peak hour traffic period. The existing geometrics will operate at LOS F for all future volume conditions.

The proposed geometrics for the widened I-17 will provide three through lanes, which are joined by two lanes from SR 101L. Northbound I-17 continues as a five-lane freeway section north of the Deer Valley Road exit ramp.

In addition to the loop ramp, other alternatives considered for the northbound exit ramp included a standard parallel exit ramp (similar to the existing configuration) and diverting I-17 traffic exiting to Deer Valley Road through the Rose Garden Lane interchange. The standard ramp layout provides good level of service (LOS B) during current AM, PM, and off-peak traffic periods. However, this configuration will provide poor level of service (LOS E) for 2025 MAG PM peak hour traffic volumes. Diverting northbound I-17 traffic through Rose Garden Lane could slightly reduce the difficulty this traffic will have in weaving two lanes to the Deer Valley Road off ramp. This diversion would allow the proposed geometrics to operate at acceptable level of service (LOS D) for 2025 MAG PM peak hour traffic volumes.

However, the study team determined that closing the existing northbound I-17 off ramp and constructing a new loop ramp north of the Deer Valley crossroad was the best alternative. The length between the gore point of the SR 101L entrance ramp and the gore point of the Deer Valley loop off ramp would be approximately 3,340 feet, providing maximum weaving and deceleration lengths.

The northbound exit loop ramp alternate changes an overloaded weave condition to an acceptable merge and diverge condition. The alternate will operate at an acceptable level of service (LOS C) for 2025 MAG PM peak hour traffic volumes.

Review of Crash Data

A review of the January 1997 – March 2000 ADOT crash data determined that three locations on the northbound roadway between MP 239.0 and MP 240.0 exhibit higher than normal accident clusters. These locations are as follows: MP 239.0, MP 239.5, and MP 240.0. The crash data as reported does not indicate that any of the design exceptions being requested are contributing to these events. The final designer shall review updated current crash history for additional data.



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Summary

In summary, granting these exceptions and variances is justified because full reconstruction of the existing roadway would impact major structural features which otherwise would not require modification, resulting in increased costs, longer construction duration, and increased impacts to adjacent properties. The requested design exceptions should be re-analyzed and eliminated if possible during final design and/or future bridge replacement projects. In addition, many of the design exceptions requested are eliminated when the geometrics are evaluated against the 2001 AASHTO Green Book values.

Your approval of these design exceptions and variances is requested. Thank you.

Sincerely,

Michael R. Chase, P.E.
Project Manager

Date: 3/22/04

Approved:

Dave Allocco, P.E.
Assistant State Engineer

Date: 4-20-04

Approved:

Jean Nehme, P.E.
Assistant State Engineer
Bridge Group

Date: 5-5-2004

